

improvement, and so it would not be surprising to see a counter-migration of West German scholars to the East, matching—maybe with a rather long lag—the migration of researchers and technicians from the East to Fraunhofer and Max Planck institutes and to industry labs in the West. The West German university system—despite the uprisings of the late 1960s, despite huge increases in general enrollments and despite the opening of new universities with progressive agendas—has remained remarkably bound in tradition. As a result one finds a great many hungry young scholars in the western states doggedly competing for a surprisingly small number of choice positions. Under the circumstances, it stands to reason that many of those who have stayed committed to academic car-

eers despite poor odds will now eagerly train their sights on new positions opening up in the five eastern states. There, they will have the opportunity to settle in communities that are still quiet and charming, to propagate the knowledge and wisdom of the West, and—once again—to help make names like Jena, Halle and Leipzig world famous.

In the months prior to unification, authorities toyed with the idea of abolishing Humboldt University, the historic university of Berlin, because it has been cloned by the (much superior) Free University of West Berlin. It seems now that Humboldt will survive and that Berlin is destined—taking the Technical University into account—to be home to three major universities.

—WILLIAM SWEET

AIP MEETING AT SANDIA FOCUSES ON TECHNOLOGY TRANSFER

Industrial competitiveness, especially in high technology, has become a critical concern in the US. Some companies are having to pare their basic-research budgets, and many consider the cost of translating new ideas into products prohibitive. Increasingly companies are combining forces, and industrial firms are more willing than ever before to contemplate cooperative ventures with the national laboratories. For a number of reasons, the labs also are increasingly receptive to partnerships with industry. And so, this year when AIP's Corporate Associates gathered for their annual meet-

ing, the featured theme was "emerging technologies and technology transfer."

The Corporate Associates are corporations and organizations that provide advice to AIP and that pay dues in support of AIP's activities. Their meeting took place this year on 23–24 October at Sandia National Laboratories in Albuquerque, New Mexico.

In his welcome to the gathering of industrial, university and AIP society leaders, Venkatesh Narayanamurti, the vice president of research at Sandia, gave some background on the lab. Sandia is a multiprogram DOE laboratory that concentrates on the research and development of non-nuclear components for nuclear weapons, and the assurance of the safety and security of those weapons. Together with the other two nuclear weapons laboratories—Lawrence Livermore National Laboratory and Los Alamos National Laboratory—Sandia is now seeking a broader role. It currently has programs in semiconductor physics, pulsed power, computer science and materials science. Sandia developed expertise in all these fields to serve its main mission, but can apply this expertise to other areas

as well, Narayanamurti said. He added that the lab is trying to make itself more "user friendly" to facilitate programs in technology transfer.

Emerging technologies

The first group of talks on the program centered on the theme of technology transfer. James Gerardo of Sandia spoke about the lab's work in thin film synthesis and surface modification, which formed the basis for Sandia's Semiconductor Equipment Technology Center, funded by Sematech, the US semiconductor research consortium. Paul Percy, also of Sandia, discussed semiconductor materials and devices that exploit the strain-induced electrical and optical properties of layers of lattice-mismatched semiconductors. Both speakers gave examples of projects in which Sandia researchers had collaborated with private industry.

Wilfred Veldkamp of MIT Lincoln Laboratories spoke about the possibilities of binary optics, which are based on diffraction rather than refraction. Federico Capasso of AT&T Bell Labs discussed several promising quantum electron devices.

In a group of talks dealing with policy matters, Ray Balcerak of the defense manufacturing office of the Defense Advanced Research Projects Agency addressed the government's role in fostering a competitive technology base. DARPA is one of several government agencies that have been very concerned about the decline in the US share of the world semiconductor industry. The regulatory side of technology was addressed by Rowland Redington of the General Electric R&D Center, who reviewed 20 years of government oversight with respect to diagnostic imaging devices such as CAT scanners.

The Corporate Associates had looked forward to a scheduled address by New Mexico Senator Pete Domenici, but the prolonged debate over the budget confined the lawmaker to Washington, DC. However, technology helped to transfer his speech to the Sandia auditorium: He sent a videotaped presentation and was on the telephone just after the tape was shown to answer questions from the audience. Domenici has cosponsored bills facilitating technology transfer and was instrumental in establishing Sematech. Domenici also helped to double DOE's defense programs budget for technology transfer to \$20 million. In his taped message, he noted that industry, which showed little interest in technology transfer for about 15 years, has looked upon it more favorably in the last three years.

CECELIA BRESCIA



Making a point,
Edward Stone of Caltech answers a question following his talk about the Voyager mission to Neptune.

In the telephone discussion with the group Domenici sounded particularly excited by the suggestion from Minas Ensanian of Electropograph Corporation (Eldred, Pennsylvania) that the government produce a booklet summarizing those aspects of patent law and protection of intellectual property that are involved in technology transfer agreements between government laboratories and industry. In a remark addressed specifically to the academics present, Domenici challenged universities to contribute to the drive for industrial competitiveness: Professors, he felt, should convince their students that manufacturing is at least as important as research.

The third group of talks at the Corporate Associates meeting highlighted several frontiers in physics. Edward Stone of Caltech, formerly the scientific director of the Voyager II mission, who has just been named director of the Jet Propulsion Laboratory, brought to the meeting many beautiful photographs taken on the mission and summarized both the knowledge and new questions that it produced. David Campbell of Los Alamos National Laboratory presented a clear exposition of the study of nonlinear processes. John Hopfield of Caltech spoke about work on neural networks and "biological" computation. Virgil Dugan, acting vice president of energy programs at Sandia, wrapped up the session with his view of the future of the energy industry.

Sandia facilities

Those attending the Corporate Associates meeting were given tours of the various Sandia facilities. Several of the facilities visited were created to simulate the effects of nuclear bombs: Hermes III, a linear induction accelerator producing 20-MeV gamma rays; Proto II, a radially converging accelerator generating soft x rays; and two pulsed nuclear reactors, one of which (SPR III) can deliver about 150 000 MW peak power. The other reactor (ACRR) was pulsed during the visit, so that the visitors could observe the emission of blue Čerenkov radiation from the water around the core.

Another facility, called STAR, is used to test the effect of shock waves on systems and components. The tour also included the Particle Beam Fusion Accelerator II. It delivers a 5 million-volt pulse in about a millionth of a second to impel an ion beam (usually lithium) toward a fusion target.

In the desert beyond Sandia's main buildings is the national solar ther-

mal test facility, with a field of 220 glass heliostats that can generate up to 5 MW of thermal power. Research there is now directed toward the design of larger, lighter-weight and more economical heliostats.

On one of the tours, the Corporate Associates representatives were introduced to Sandia's efforts in semiconductors. The research and development there includes work on silicon integrated circuits, compound semiconductor devices and materials, and semiconductor structures such as sensors and micro-machined devices. One requirement of VLSIs developed at the lab is resistance to high levels of radiation. At the Center for Compound Semiconductor Technology, formed in 1988, visitors saw the clean room and the facilities for molecular-beam epitaxy, metal-organic chemical vapor deposition, ion implantation

and photolithography. They also visited a lab for the development of optoelectronics.

The tour also featured a robotics lab. Sandia is DOE's leading lab for the application of robotics to hazardous environments and to small-batch manufacturing that requires frequent reconfiguration.

At the meeting's banquet AIP presented its science writing award to Bruce Murray of Caltech for his book *Journey into Space* (see story below). Then Albert Narath, director of Sandia Labs, spoke on the theme of technology transfer. He echoed the sentiment of the other participants in the conference that despite the many practical difficulties of sharing technologies across industries and national labs, the benefits of cooperation at the precompetitive stage promise to be high.

—BARBARA GOSS LEVI

MURRAY OF CALTECH WINS AIP SCIENCE WRITING PRIZE

At the AIP Corporate Associates meeting held at Sandia National Laboratories in Albuquerque, New Mexico, in October, Bruce C. Murray, a professor of planetary science at Caltech, was presented with this year's AIP science writing award to a scientist. The award consists of \$3000 and a certificate. Murray was chosen for his book *Journey Into Space: The First Thirty Years of Space Exploration* (Norton, New York, 1989), a personal account of his involvement in planetary missions—and the politics sur-

rounding those missions—over the past three decades. (For a review of the book, see PHYSICS TODAY, October, page 95.)

As director of the Jet Propulsion Lab from 1976 to 1982 and as an active researcher in planetary science, Murray has been a central figure in the debate over US policy on exploration of the solar system and has frequently criticized NASA's preoccupation with the shuttle program, which he and others claim has siphoned off research dollars from other, smaller projects in planetary science and astrophysics.

Murray received a PhD in geology from MIT in 1955 and joined the faculty at Caltech in 1960. He has been involved in numerous exploration projects, including Mariner missions to Mars, the Mariner mission to Mercury and Venus, and the Voyager mission to the outer planets. Murray is currently analyzing data from the Soviet Union's Phobos 2 spacecraft and is collaborating with French and Soviet scientists on a balloon probe for the 1994 Soviet Mars mission. With Carl Sagan and Louis Friedman, he founded the Planetary Society in 1980.



Bruce Murray receives his award for science writing from AIP. Murray was honored for his book *Journey into Space*.

AIP's GEMANT AWARD GOES TO BERNSTEIN FOR PHYSICS WRITING

Jeremy Bernstein, a professor of physics at Stevens Institute of Tech-